ADJUSTABLE RECLINING CHAIR

This invention relates to powered furniture and in particular concerns powered recliner chairs and lift-recliner chairs.

A typical recliner chair comprises a base that sits on the floor, a seat portion that supports a generally horizontal seat cushion and a back portion that may be fixed to the seat or pivotally connected to it. Recliner chairs are also usually provided with a footrest at the front of the chair which is movable between a vertical orientation when the chair is in a generally upright configuration for sitting, and a generally horizontal orientation when the chair is reconfigured for reclining. Recliner chairs are known where the seat portion moves during the reclining operation to tilt the seat slightly downwards at the rear edge and raise the front edge of the seat. Other types of recliner seat are known where the seat is fixed with respect to the base and only the back and footrest are moved when the seat is reclined.

Various types of lift-recliner chairs have been developed, principally for the elderly and less physically able people, to provide assistance when moving out of the chair to a standing position. Typical lift recliner chairs are described in US-A-4,852,939, US-A-4,993,777 and US-A-5,265,935 which describe various arrangements of levers, links and motors for raising the chair from a seated to a standing position.

The actuating arrangements of known recliner and lift-recliner chairs are generally mechanically complex adding significantly to the cost, weight and complexity of the chair. In addition, in known lift-recliner chairs the seat and back portion of the chair are typically lifted off of the base support structure (typically a metal frame) when the chair is raised towards the standing position creating entrapment points between the underside of the seat and the base, and in particular in between the levers and links of the actuating arrangement that are exposed between the seat and the base support structure when the chair is raised.

There is a requirement to provide a simple actuating arrangement for recliner and lift-recliner chairs which requires fewer moving components than hitherto known designs, and also an actuating arrangement that is relatively simple to construct and to integrate within the structure of a recliner or lift recliner chair.

According to a first aspect of the invention there is provided a lift-recliner chair comprising a base portion, a seat portion pivotally connected to the base portion, a back portion pivotally connected to the seat portion and actuator means for moving the seat portion with respect to the base portion and the back portion with respect to the seat portion whereby to alter the configuration of the chair, wherein the said actuator means is substantially enclosed within the base portion in all configurations of the chair.

The lift-recliner chair according to the above aspect of the invention has the advantage that the actuator means is enclosed within the base portion of the chair, thereby

providing a chair in which the actuator means is wholly integrated within the structure of the chair. This can substantially eliminate the risk of entrapment when the chair is moved from one configuration to another, for example when raised or lowered. The lift-recliner chair according to this aspect of the invention also enables all moving parts of the actuating mechanism to be enclosed within the base portion of an upholstered chair.

The seat portion of the chair may be moved between a substantially horizontal position in which at least part of the seat portion is nested with the base portion and an inclined position in which the seat is extended telescopically from the base. The nested arrangement of the seat portion and the base readily enables the actuator means to be enclosed within the base on the underside of the seat cushion part of the seat portion so that the actuator means is guarded by the base and seat structure and also hidden from view so that the aesthetic appearance of the chair is also significantly improved. It will be readily apparent to the skilled person that by carefully selecting the clearance dimensions between the nested parts of the chair entrapment points can be substantially eliminated. This is a significant advantage when considered in relation to known types of lift recliner chair where a significant risk of entrapment exists between the moving parts on the underside of the seat portion of the chair between the seat and the base and between the seat and the base parts when the seat is moved.

In preferred embodiments the seat portion is nested within and extendable from the base portion.

Preferably, the base portion comprises a front and a back panel and a pair of substantially vertical side panels between the front and back panels, and the said seat portion comprises a seat panel and pair of substantially vertical side panels arranged substantially parallel with and adjacent to the respective base portion side panels.

Preferably, the base portion has a rectangular shape with the side and back panels comprise part of the structural framework of the chair with the front panel being movable with respect to the other panels of the base to a horizontal orientation to provide a foot rest.

Preferably, the seat portion is pivoted to the base portion about a pivot axis positioned towards the front of the base portion, that is to say towards the front panel of the base. In this way it is possible to raise and lower the seat portion of the chair by tilting the seat portion about its pivot axis to provide the lifting function of the chair. By positioning the pivot axis towards the front of the chair the person seated in the chair can be gently raised towards the standing position with substantially no effort since the movement of the seat gently straightens the legs of the person seated since the knee joints of the user's legs are substantially coincident with the pivot axis as the seat is pivoted and raised.

In preferred embodiments the back portion comprises a generally rectangular frame and a pair of pivot arms which extend from the frame and pivotally connect the frame to the seat portion. In this way the pivot arms may comprise part of a bell-crank arrangement for moving the back portion about a pivot axis spaced from the

rectangular frame of the seat back. The extended pivot arms readily enable the back portion to be moved by actuator means enclosed within the enclosed region on the underside of the seat or at the rear of the seat cushion. This is possible in embodiments where the pivot arms extend into the region on the underside of the seat panel, or into the region at the rear of the seat cushion, where they can be connected to an actuator without interfering with other parts of the seat.

In preferred embodiments the pivot arms extend parallel with and adjacent to the respective vertical side panels of the seat, and preferably the pivot arms are positioned on the interior side of the vertical side panels of the seat.

Preferably the back portion pivots away from the seat portion when the seat is moved to an inclined position, that is to say the angle between the seat panel and the seat back is increased. Preferably, the back portion pivots away from the seat portion when the seat is moved to a half raised position.

In preferred embodiments the seat and back portions of the chair are moved independently of each other by dedicated first and second actuators, including a first actuator for moving the seat portion and a second actuator for moving the back portion. The first and second actuators are preferably controlled by a microprocessor or the like so that the movements of the seat and back portions of the chair are co-ordinated.

Preferably, the first and second actuators are mounted in fixed relation to the base portion of the chair. In preferred embodiments the actuators are fixed to a structural, preferably metal, frame on which the side and rear panels of the base are mounted. In other embodiments the first actuator for moving the seat portion is fixed to the base and the second actuator for moving the back portion is fixed relative to the seat portion.

The front panel of the base portion is preferably pivotally mounted with respect to the side and rear panels of the base so that it may be moved from a generally vertical orientation in the normal seated configuration of the chair to a generally horizontal orientation in a reclined configuration of the chair. In this embodiment a third actuator is provided for moving the front panel about its pivot axis. It is preferred that the third actuator is fixed in relation to the side panels of the base and preferably mounted to the same metal frame as the first and second actuators.

According to a second aspect of the invention there is provided a recliner chair comprising a base portion, a seat portion, and a back portion pivotally mounted with respect to the seat portion, and actuator means for moving the back portion about its pivot axis between a generally upright position and a reclined position, wherein the said actuator means is enclosed within the base portion on the underside of the seat.

The recliner chair according to the second aspect of the invention comprises many but not all the features of the lift-recliner chair according to the first aspect of the invention including the enclosure of the actuator means within the base portion of the

chair on the underside of the seat. The advantages discussed in relation to the recliner chair relating to the enclosure and integration of the actuator means in the base portion of the chair are therefore equally relevant and applicable to the recliner chair according to the second aspect of the invention.

Preferably, the base portion of the recliner chair comprises a front panel pivotally mounted with respect to the seat portion, and the actuator means comprises a first actuator for moving the back portion about its pivot axis and a second actuator for moving the front panel about its pivot axis from a generally vertical orientation to a generally horizontal orientation.

According to a third aspect of the present invention there is provided a recliner chair comprising a base portion, a seat portion, and a back portion pivotally mounted with respect to the base portion, the base portion having a pair of lateral side panels and a front panel pivotally mounted with respect to the said side panels, and a common actuator for moving both the back portion about its pivot axis and the front panel about its pivot axis to alter the configuration of the chair form a generally up-right configuration to a generally reclined configuration, wherein the back portion moves from a generally vertical to an inclined orientation and the front panel moves from a generally vertical to a generally horizontal orientation.

The recliner chair according to the third aspect of the invention shares many of the advantages of the chairs of the aforementioned first and second aspects of the invention but has the further advantage that the chair has a single common actuator for

moving both the back portion of the chair and the front panel, so that the configuration of the chair may be changed by the activation of a single actuator acting on both of the backrest and front panel. The third aspect of the invention therefore provides a relatively simple and compact actuator arrangement that is readily integrated into the interior of the base on the underside of the seat panel of the chair.

Preferably, the recliner chair according to the third aspect of the invention further comprises a first cam means for determining the movement path of the back portion with respect to the base portion and a second cam means for determining the movement path of the front panel with respective side panels. The first and second cam means readily and reliably ensure the movement of the front panel and back portion of the chair are coordinated when the chair is moved from its upright position to its fully reclined position and the intermediate positions therebetween.

In preferred embodiments the first and second cam means are engaged by a cam engagement means connected to the actuator. Preferably the cam engagement means is pivotally mounted with respect to the sides of the base portion for movement by the actuator. It is also preferred that the first and second cam means are pivotally mounted with respect to the sides of the base and that they are pivotally mounted about a common axis.

In preferred embodiments the cam engagement means comprises at least one engagement pin and that the first and second cam means comprise first and second pin engagement slots engaged by the pin.

In preferred embodiments the first and second slots are provided in first and second cam plates pivotally mounted in the interior of the base portion on both sides of the base with each pair of the first and second cam slots being engaged by a respective engagement pin. This arrangement readily enables the actuator load to be transferred evenly to the back portion of the chair and the front panel on both sides of the chair. In preferred embodiments the common actuator comprises a linear actuator.

Various embodiments of the present invention will now be more particular described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view from the front of the frame of the lift-recliner chair according to an embodiment of the present invention;

Figure 2 is the perspective view of the frame of the chair shown in Figure 1 viewed from the underside of the chair frame;

Figure 3 is a perspective view of a chair of Figure 1 from above;

Figure 4 is a perspective view of the frame of the chair of Figure 1 viewed from the side showing the rear of the chair with the frame in a partly raised configuration;

Figure 5 is a perspective view similar to that of Figure 1 of the frame of the chair shown in a fully raised configuration;

Figure 6 is a cross-section view through the base of a lift-recliner chair according to another embodiment of the invention;

Figure 7 is a side view of a lift-recliner chair according to a further embodiment of the invention;

Figure 8 is a side view of the chair of Figure 7 shown with a seat portion in a raised configuration;

Figure 9 is a perspective view of the rear of the chair of Figure 8;

Figure 10 is a side view of the chair of Figure 7 shown with a back portion in a reclined configuration and a foot panel in a raised configuration;

Figure 11 is a diagrammatic view of the back section of the chair of Figures 7 to 10;

Figure 12 is a diagrammatic perspective view showing the underneath of the chair of Figures 7 to 11; and

Figure 13 is a diagrammatic side view showing the working mechanisms of the chair of Figures 7 to 12.

Figure 1 shows the structural frame of a lift-recliner chair 10 according to an embodiment of the present invention. The frame, and hence the chair, comprises three main sections including a base portion 12 a seat portion 14 and a back portion 16. The base portion includes a pair of lateral side panels 18 and a rear panel 20 secured to the respective sides of the rectangular metal frame 22 on the underside of the chair. The panels 18 and 20 and the other panels of the frame of the chair shown in Figures 1 to 5 are preferably of MDF type board material but the invention also contemplates other board material such as wood, plywood or plastic etc. as is typically used in the furniture industry for upholstered and non-upholstered furniture

The metal frame 22, best seen in the view of Figure 2, comprises a pair of lateral side members 24, a front cross member 26 extending between the side members 24 at the

front of the chair and a pair of intermediate cross members 28 and 30 which extend between the side members 24 at a point midway along the length of the side member and towards the rear of the chair respectively. The side panels 18 are secured to the side members 24 of the frame with the rear panel 20 secured to the ends of the respective side panels at the rear of the chair to provide a box-type structure for supporting the other parts of the chair.

The base portion 12 further comprises a front panel 32 which is pivotally mounted to the lateral side panels 18 of the base by a linkage arrangement 34 at both ends of the panel 32 adjacent to the respective side panels 18. The linkage arrangement 34 is of a known arrangement and enables the front panel 32 to be moved from the position shown in Figure 1, where it has a generally vertical orientation, to the position shown in Figure 2, where it has a substantially horizontal configuration.

The seat portion 14 comprises a similar box-type panel frame secured to a further metal rectangular frame 36, as can best be seen in the view of Figure 3. The metal frame 36 includes a pair of lateral side members 38 to which the lateral side panels 40 of the seat are attached, a front cross member 42 at the front of the seat portion, a rear cross member 44 at the rear of the seat and an intermediate cross member 46 approximately midway between the front member 42 and rear member 44. The cross members extend between the side members 38. The rectangular frame section between the cross members 44 and 46 at the rear of the seat has a slightly reduced width dimension to that of the rectangular frame section between the front cross member 36 and intermediate member 46. For reasons that will become apparent later

in this description this reduced width dimension provides a clearance between the side members 38 of the frame and the respective side panels 40 of the seat towards the rear of the chair. The clearance dimension is approximately equal to the width dimension of the metal tubes that constitute the metal frame.

The seat portion 14 is nested within the base portion 12 and pivotally connected to the base portion about a pivot axis perpendicular to the lateral sides 40 at the front of the chair. The seat portion is pivotally mounted to the base portion by pivot pins (not shown) which extend from pivot plates 48 through corresponding apertures in the side panels 40 and 18 towards the front of the chair.

The rear most ends of the side panels 40 are arcuate having a centre of curvature defined by the pivot axis of the mounting pins so that the rear part of the seat portion can move freely with respect to the base end panel 20 when the seat portion is pivoted about its axis in use. Similarly, an end panel 50, as seen in Figure 4 which extends between the side panels 40 at the rear of the chair also has a curvature which follows the curvature of the arcuate end faces 49, that is to say it has the pivot axis of the seat portion as its centre of curvature.

The width dimension of the seat portion between the side panels 40 is slightly less than the width dimension between the base side panels 18 so that the seat portion nests between the side panels 18 when in the sitting configuration shown in Figure 1 and is extendable telescopically there from when pivoted about its pivot axis to the lift position shown in Figure 5.

The back portion of the chair frame also comprises a rectangular frame in which a pair of a pair of elongate pivot arms 52 on the lateral sides of the back portion 16. The arms 52 are joined together by a pair of cross members 54 and 55 towards the top and the bottom part of the back portion 16. The back portion 16 is pivotally connected to the seat portion 14 in the same way that the seat portion is pivotally connected to the base 12, that is to say by means of a pair of pivot pins 56 secured to pivot pin plates 58 on the respective side panels 40. The pins 56 pass through corresponding apertures in the respective panels 40 and pivot arms 52. As can best be seen in the view of Figure 2 the pivot arms 52 extends beyond the pivot pins 56 into the interior region of the base portion 12. The lower part of the pivot arms 52 pass through the gaps created between the undersize frame part towards the rear of the frame 36 and the side panels 40 on the seat. The ends of the pivot arms extend beyond the metal seat frame 36 into the region on the underside of the frame 36 and are joined together at their remote ends by a metal cross bar member 60.

The pivot arms 52 are free to rotate with respect to the seat portion, and hence the base portion, in a manner that enables the back portion to be reclined with respect to the seat portion either for altering the configuration of the chair from an upright configuration to a reclined configuration or to a raised configuration as shown in Figure 5.

Three linear actuators 62, 64 and 66 are mounted on the metal frame 22 in the interior of the base portion 12 on the underside of the seat frame 36. A first of the actuators 62 is mounted on the intermediate cross member 28 with the end of the actuator ram

63 fixed to the rear face of the front panel 32 adjacent to the upper edge 70 of the front panel. Extension of the actuator arm 63 moves the front panel from its generally vertical orientation as shown in Figure 1 to the horizontal orientation shown in Figure 2 to provide a footrest support. Actuator 64 is mounted to the front cross member 26 of the frame 22. The actuator arm 65 of the actuator 64 is connected at its extendable end to the cross member 46 of the metal seat frame 36 so that extension of the actuator arm 65 moves the seat portion 14 about its pivot access to tilt the seat portion between the positions shown in Figures 1 and 5. The third actuator 66 is also mounted to the cross member 26 of the metal frame 22 with the extendable end of its actuator arm 67 connected to the cross member 60 extending between the pivot arms 52. Extension of the actuator arm 67 by the actuator 66 moves the back portion 16 about its pivot access to alter the tilt angle of the back portion 16 with respect to the seat portion 14. Retraction of the actuator arm 67 causes the angle between the back portion and seat portion to increase, for example when the chair is reclined or when the seat portion 14 is raised to the standing position. Extension of the actuator arm 67 reverses this operation and when fully retracted the back portion is moved to its upright position with respect to the seat portion.

Actuators 62, 64 and 66 are of a known type, for example Dewart type 34931 linear actuators, that comprise electrical motors controlled by control electronics which may be in the form of a microprocessor suitably programmed to provide co-ordinated control of the actuators for co-ordinated movement of the moveable sections of the chair, both for reclining and lifting movements.

It will be understood that the configuration of the chair shown in Figures 1 to 5 may be changed from the upright configuration shown in Figure 1 to a reclined configuration where the back portion 16 is reclined with respect to the remainder of the chair and the front panel 32 is raised to provide a foot rest with or without movement of the seat portion 14, and that the configuration may be changed from the upright configuration to the raised configuration shown in Figure 5 for assisting the seated user out of the chair.

If the seat portion 14 is tilted to the raised configuration shown in Figure 5 with the back portion 16 remaining in its upright configuration this could cause problems by dictating or even forcing an individual to move out of the chair directly from a seated position. Adjusting from a seated position to a standing position as the seat portion tilts forward may not be possible or desirable for all users. If the back portion 16 is moved to its reclined position prior to or during movement of the seat portion 16 then a user can be placed into a standing position by the chair by the time the seat portion 16 has tilted to the point at which the user leaves the chair. The chair may therefore have the facility to provide co-ordinated pivotal movement of the seat portion 14 and the back portion 16 in which the back portion 16 reclines as the seat portion 14 lifts. In this way an individual is moved from a seated to a standing position by the chair to avoid the possibility of them being pushed out of the chair whilst still in a seated position. In a preferred embodiment of the invention the back portion begins to tilt rearwards when the seat portion is pivoted, or raised, at a point half way between its lowered and raised positions, preferably the movement of the seat and back rest portion is co-ordinated by control signals generated by software implemented in the

microprocessor controller.

A recliner chair according to another aspect of the present invention comprises an operating mechanism as shown in the drawing of Figure 6. Figure 6 is a cross section view through the base portion of a recliner chair with an operating mechanism 71 housed substantially within the interior of the base of the chair. The base of the chair shown in Figure 6 is similar to the base of the chair described with reference to Figures 1 to 5 in that it comprises a generally rectangular box-type structural framework including a metal base frame 72, of a tubular metal construction, and a pair of lateral side panels 74, preferably but not necessarily of MDF board material, bolted to the side members of the frame 72 on respective sides of the chair.

A front panel 76 is pivotally mounted to the side panels 74 by respective link assemblies 78 mounted on the interior side of the side panels 74 on both sides of the chair. The link assembly 78 and front panel 76 are substantially identical to the linkage system 34 and front panel 32 of the chair described with reference to Figures 1 to 5. The link assembly 78 on each side of the chair includes four link elements that are pivotally connected together, including a first link element 80 which is pivoted at one end to the side panel 74 and at its other end to one end of a second link element 82. The other end of the link element 82 is pivotally connected to a bracket 83 secured to the interior facing surface of the front panel 76 towards the top edge of the panel when configured in its vertical orientation as shown in Figure 6. A third link element 84 is pivotally connected at one end thereof to the side panel 74 between the link element 80 and the front panel 76 and at the other end thereof to one end of a

fourth link element 86, the other end of which is also pivotally connected to the bracket 83 at a position spaced from the link 82 and approximately one third along the depth of the front panel 76. The second and third link elements 82 and 84 are also pivotally connected together at the point of their mutual intersection (not shown).

The front panel 76 is deployed from its vertical orientation shown in Figure 6 to a generally horizontal orientation to provide a foot rest by activation of a linear actuator 88 located within the interior of the base of the chair. The linear actuator 88 may be a Dewart type 34931 linear actuator comprising an electric motor 90 at one end thereof and a piston arm 92 at the other end thereof which is extendable from a housing 94. The end of the actuator 88 nearest the motor section 90 is pivotally connected to a bracket 96 integral with and upstanding from the base frame 72 at the front of the frame 72. At the other end of the actuator the extendable arm 92 is pivotally connected at its end to a bracket 98 extending on one side of a square cross section metal tube member 100 to which extends along the width of the chair and is welded to respective metal bell-crank plates 102 at opposite sides of the chair, only one of which is shown in the cross-section view of Figure 6. The bell-crank plates 102 are substantially parallel with the respective side panels 74 and perpendicular to the metal tube which connects the bell-crank plates 102 on either side of the chair together. Each bell-crank plate 102 is pivotally connected to its respective side panel 74 by a pin type mounting 104 positioned towards the top edge 106 of the side panel 74. Each bell-crank plate 102 is provided with an upstanding engagement pin 108 extending perpendicular to the plane of the plate. The pin 108 constitutes a cam engagement means and is engaged within respective first and second cam slots 110 and 112

provided in the respective cam plates 114 and 116 pivotally mounted to the respective side panels 74 towards the rear of the chair on both sides thereof. The first and second cam plates 114 and 116 are pivotally mounted on a common pivot pin 118 which extends into the interior of the base portion from the side panel 74. The cam plates 114 and 116 are generally planar and parallel with the bell-crank 102 and the side panel 74.

The first cam plate 114 constitutes a seat back cam for determining the movement path of the back portion of the chair (not shown) with respect to the base. The second cam plate 116 constitutes a footrest cam for determining the movement path of the front panel 76 with respect to the side panels of the base. The seat back cam 114 has a shallow V-shape with the mounting pin 118 positioned at the apex of the V. The upper arm of the V, i.e. the arm shown towards the top of the drawing in Figure 6, constitutes a lever for connecting the seat back cam plate to the back portion of the chair, while the cam slot 110 is formed in the lower arm of the V. The cam slot 110 includes a linear portion 120 and an arcuate portion 122 with the linear portion 120 extending towards the extremity of the V and the arcuate portion disposed towards the middle part of the V in the lower arm. The curvature of the arcuate portion 122 is such that the side of the slot facing the front of the chair in the view of Figure 6 is concave.

The cam plate 116 is generally arcuate and is pivotally connected at one end of the arc to the mounting pin 118 and at its other end to a linear push rod link element 124. The cam slot 112 in the cam plate 116 also comprises a linear section 126 and a longer arcuate section 128. The arcuate section 128 of the slot extends along the majority of the arcuate length of the cam plate from the lower end of the plate that is connected to the push rod 124 along approximately 75% of the arc of the plate where the remainder of the slot is linear.

The linear push rod 124 connects the link assembly 78 to the cam plate 116. One end of the push rod 124 is pivotally connected to the first link 80 at a point substantially midway along its length, and the other end is pivotally connected to the cam plate 116.

The operating mechanism described with reference to Figure 6 provides for simultaneous co-ordinated pivotal movement of the back of the chair and the foot rest front panel 76. In the drawing of Figure 6 the operating mechanism is shown configured for a chair in an upright configuration with the front panel foot rest 76 retracted to the vertical position at the front of the chair and the back portion of the chair substantially upright with respect to the base and seat. By activating the actuator 88 to retract the arm 92 into the housing 94 the bell crank 102 is caused to rotate about the pin 104. This movement causes the cam engagement pin 108 to follow a circular path about the centre of the pin 104, in a clockwise direction when viewed in the plane of the drawing of Figure 6. This then causes the cam plate 114 to follow the pin 108 so that the cam plate rotates about the mounting pin 118 in a clockwise

direction, as viewed in the plane of the drawing of Figure 6, thereby causing the back of the chair to rotate towards a reclined position with respect to the seat. Simultaneously, the slot 112 in the cam plate 116 is constrained to follow the movement of the cam pin 108 so that the plate 116 also rotates in a clockwise direction about the mounting pin 118. The fixed relationship between the position of the pin 118 and the end of the push rod 124 connected to the plate 116 causes the push rod link 124 to move in a general direction towards the front panel of the chair pivoting the links 80 and 84 of the link assembly also in a clockwise direction so that the front panel 76 is moved from the vertical position shown in Figure 6 towards its deployed horizontal position to provide a foot rest.

Figures 7 to 13 show a lift-recliner chair 210 according to an alternative embodiment of the present invention. The chair 210 is similar to the chair 10 shown in Figures 1 to 5.

The chair 210 comprises a base portion 212, a seat portion 214 and a back portion 216. The seat portion 214 is pivoted with respect to the base portion 212 and is movable between the lowered position shown in Figure 7 and the raised position shown in Figures 8 and 9. The back portion 216 is pivoted with respect to the seat portion 214 and is movable between the raised position shown in Figure 7 and the reclined position shown in Figure 10; in addition a front panel 232 is pivoted with respect to the base portion 212 and can be moved from the vertical position of Figure 7, and best shown in Figure 13, to the horizontal position shown in Figure 10.

The base portion 212 includes a pair of lateral side panels 218 and a rear panel 220 is secured to the rear of the side panels 218. Together with the front panel 232 the base portion 212 comprises a box-type structure.

As shown in Figures 12 and 13 the side panels 218 are joined at their lower edges to a metal base frame 222 comprising a pair of lateral side members 224, a front cross member 226 extending between the side members 224 at the front of the chair and an intermediate cross member 230 which extends between the side members 224 towards the rear of the chair.

The seat portion 214 comprises a pair of lateral side panels 240 joined by a central, mainly wooden, rectangular frame 236. The frame 236 comprises a pair of side members 238 and front and rear cross members 242, 244 extending between the front and rear side members 238.

At the front of the seat section frame 236 the side members 238 are attached to the side panels 240 by a pair of metal reinforcement brackets 241. At the rear of the seat section frame 236 a metal cross member 237 is attached to and extends between the panels 240 and is also attached to the frame side members 238. A further cross member 219 is attached to and extends between the side panels 240 directly below the cross member 237 at the lower rear corners of the panels 240.

The seat portion 214 is nested within the base portion 212 and is pivotally connected to the base portion 212 about a pivot axis perpendicular to the side panels 240 by pivot pins 247. The pins 247 extend from pivot pin mounting plates 248 positioned at the respective upper front corners of the side panels 240 and extend through the panels 240 and through the side panels 218 of the base portion 212.

The rear ends of the side panels 240 are arcuate and an end panel 250 extending between the side panels 240 is correspondingly curved. As is the case for the chair 10 of Figures 1 to 5, the centre of curvature of the rear ends of the side panels 240 and the end panel 250 is determined by the pivot axis 247 of the seat portion so that the seat portion 214 can extend and retract telescopically, with minimum clearance, within the base portion 212 between the lowered position shown in Figure 7 and the raised position shown in Figures 8 and 9.

As shown best in Figure 11, the back portion 216 comprises a pair of elongate pivot arms 252 joined by a top cross member 254, an intermediate cross member 257 and a bottom cross member 255. Two outer arms 259 lie outwardly spaced from and parallel to the pivot arms 252. The arms 259 are connected by the top cross member 254 and the intermediate cross member 257, and terminate slightly below the bottom of the pivot arms 252. The three cross members 254, 255, 257 aid in the attachment of webbing (not shown) in the upholstering of the chair 210. As can be seen in Figure 7 and 8 the pivot arms 252 are provided with metal brackets 203 for mounting the back portion 216 on corresponding interlocking bracket parts 201a of L-shape bell crank members 201.

A metal cross member 260 extends between and is fixed to the L-shape members 201. The pivot arms 252 thereby slot into the respective leg 201a portions of the L-shape member 201. The other leg portions 201b of the L-shaped brackets 201 connect the brackets to respective pivot pins 256 extending through the panels 240. The back portion 216 is thereby pivotally connected to the seat portion 214.

As shown best in Figures 12 and 13, three linear actuators 262, 264, 266 are provided within the base portion for movement of the front panel 232, the seat portion 214 and the back portion 216 respectively.

The actuator 262 is mounted centrally on the rear cross member 230 with the actuator ram 263 fixed to the rear face of the front panel 232 via a bracket 235. The actuator 263 is of the 'push only' type in which the piston is not attached to the screw jack (not shown). Accordingly the actuator 262 can move the panel 232 from the vertical position shown in Figure 7 to the horizontal position shown in Figure 10.

The return action is provided not by the actuator 262, but by the weight of the panel 232 and by a lightly tensioned elastic cord 234 strung between bolts 234a, 234b which extend from the points of connection of the two ends of the actuator 262 to the panel 232 and the cross member 228 respectively. Because the actuator 262 is not involved in the return movement of the panel, if an object, such as a leg or arm, becomes trapped by the panel 232 as it moves towards the vertical position then the object is held only by the weight of the panel 232 and the tension of the cord 234. Accordingly the force applied to the object by the panel 232 is minimised and can easily be

overcome compared to a system using an actuator to effect the return action.

The panel 232 is connected to the base portion 212 via two hinges 233, one at either side of the panel 232. Each hinge 233 comprises an arcuate quarter circle plate 233a connected at one of its circumferential ends to the panel 232 and at its other circumferential end to a linear radially extending plate 233b. The linear plate 233b is pivotally connected to the base side panels of the chair by the pivot pins 247 extending from the base portion side panels 218 through the linear plates and through the side panels 240 of the seat section to the mounting plates 248.

The main pivot point provided by pivot pins 247 thereby defines the pivot axis for both the panel 232 and the seat portion 214. This arrangement also means that the hinges 233 slide between the side panels 240 of the seat portion 214 and the side panels 218 of the base portion 212 when extended and retracted.

The positioning of the combined main pivot points of the foot rest 232 and the seat portion provided by the pivot pins 247 approximately at the upper front corners of the base portion 212 and seat portion 214, coincides with the natural position of the seated user's knee joint which brings ergonomic advantages. The same advantage could, of course, be achieved if the pivot points for the front panel and the seat portion were slightly spaced apart but still in the same general area so that they are roughly coincident with the seated user's knee joint.

Because the panel 232 is connected to the base portion 212 via hinges 233 the panel 232 can undergo only a rotation movement with no radial extension. As a result the position of the panel 232 may not extend away from the chair sufficiently to suit all users. Accordingly, in other embodiments (not shown) the chair may have some means of increasing the distance the panel extends away from the seat portion 214. For example, the panel 232 or a part thereof may be telescopic so that it moves to a position further away from the seat portion 214 during or following the pivoting movement. Alternatively a 'flipper board' arrangement could be used, in which a further panel is pivotally attached to the main foot panel 232 and can be flipped over from a position in which it rests on the panel 232 to a position in which it is co-extensive with the panel 232 to increase the length of the panel.

The actuator 264 is mounted centrally on the front cross member 226. The actuator ram 265 is fixed centrally to a cross member 237 which spans between and is attached to the side panels 240 and supports the rear of the seat section frame 236. The front of the seat section frame 236 is carried on a pair of brackets 241 attached to the frame members 238 and to the inner faces of the side panels 240.

As discussed above, the side panels 240 are pivotally connected to the main pivot points so that the seat portion 214 pivots about the pivot points under the control of the actuator 264 as shown in Figures 8 and 9.

The actuator 266 is mounted centrally on a cross member 219 which extends between and is fixed to the side panels 240 of the seat portion. The actuator ram 267 of actuator 266 is connected centrally to the cross member 260 at a point offset from the pivot axis 256 to provide a bell crank type lever. The bell crank arrangement means that the back portion 216 can be lowered to the position shown in Figure 10 by retracting the ram 267, or raised to the position shown in Figure 7 by extending the ram 267. The back portion 216 can be moved at the same time as movement of the seat portion 214 and/or the footrest panel 232 or independently thereof as previously described with reference to the embodiment of Figures 1 to 5.

Although aspects of the invention have been described with reference to the embodiments shown in the accompanying drawings, it is to be understood that the invention is not so limited to those precise embodiments and that various changes and modifications may be effected without further inventive skill and effort. For example, the lift recliner chair described with reference to Figures 1 to 5 may be modified to provide a reclining function only in the sense that the base portion of the chair is provided with only two actuators, one for reclining the back portion of the chair with respect to the base and a fixed seat, and another for deploying the front panel from its vertical position to its horizontal position to provide a foot rest for the chair. It will be appreciated that various changes and modifications may be made to the chairs described herein with any of the integers described in one embodiment being interchangeable with integers in another embodiment, and that the embodiments maybe modified by deletion or addition of any of the integers described with reference to any of the embodiments described herein.